ANSWERS TO CHAPTER 7

CONTENT LEARNING ACTIVITY

Characteristics of Skeletal Muscle
1. Contractility; 2. Excitability; 3. Extensibility; 4. Elasticity

Structure
A. 1. Epimysium (fascia); 2. Muscle fasciculus; 3. Perimysium; 4. Muscle fiber; 5. Endomysium
B. 1. Myofibril; 2. Actin myofilament; 3. Troponin; 4. Tropomyosin; 5. Myosin myofilament
C. 1. Sarcomere; 2. Z disk; 3. I band; 4. A band; 5. H zone; 6. M line
D. 1. Sarcoplasm; 2. Sarcolemma; 3. T tubules; 4. Sarcoplasmic reticulum; 5. T tubules
E. 1. Perimysium; 2. Epimysium (fascia); 3. Fasciculi; 4. Endomysium; 5. Muscle fibers; 6. Sarcoplasmic reticulum; 7. Transverse tubule; 8. Myofibrils; 9. Actin myofilament; 10. Myosin myofilament
F. 1. Sarcomere; 2. Z disk; 3. Actin myofilament; 4. Myosin myofilament; 5. M line; 6. H zone; 7. A band; 8. I band; 9. Tropomyosin; 10. Actin; 11. Troponin; 12. Myosin molecule

Membrane Potentials
A. 1. Higher; 2. More; 3. Positively
B. 1. Increases; 2. Into; 3. Depolarization; 4. Decreases; 5. Increases; 6. Out of; 7. Repolarization; 8. Action potential; 9. Out of; 10. Into

Nerve Supply
1. Motor neuron; 2. Neuromuscular junction; 3. Motor unit; 4. Synaptic cleft; 5. Acetylcholine; 6. Acetylcholinesterase

Muscle Contraction
A. 1. T tubules; 2. Sarcoplasmic reticulum; 3. Troponin; 4. Tropomyosin; 5. Cross bridges; 6. Sliding filament mechanism; 7. ATP molecules; 8. Heat; 9. Sarcoplasmic reticulum
B. 1. Muscle twitch; 2. All-or-none response; 3. Lag phase; 4. Contraction phase; 5. Tetanus; 6. Recruitment
C. 1. ATP; 2. Creatine phosphate; 3; Aerobic respiration; 4; Anaerobic respiration; 5. Aerobic respiration; 6. Anaerobic respiration; 7. Oxygen debt; 8. Muscle fatigue
D. 1. Isometric; 2. Isotonic; 3. Eccentric; 4. Muscle tone
E. 1. Slow-twitch muscle fibers; 2. Slow-twitch muscle fibers; 3; Fast-twitch muscle fibers; 4. Fast-twitch muscle fibers

Smooth Muscle and Cardiac Muscle
1. Smooth muscle; 2. Both smooth muscle and cardiac muscle; 3. Both smooth muscle and cardiac muscle; 4. Cardiac muscle

General Principles of Muscle Anatomy
1. Tendon; 2. Aponeurosis; 3. Origin; 4. Insertion; 5. Belly; 6. Synergists 7. Antagonist; 8. Prime mover; 9. Fixator

Muscles of the Head and Neck
A. 1. Occipitofrontalis; 2. Orbicularis oculi; 3. Orbicularis oris and buccinator; 4. Buccinator; 5. Zygomaticus; 6. Levator labii superioris; 7. Depressor anguli oris
B. 1. Temporalis and masseter; 2. Pterygoid muscles; 3. Intrinsic tongue muscles; 4. Hyoid muscles; 5. Soft palate muscles; 6. Pharyngeal constrictors; 7. Sternocleidomastoid muscle

Trunk Muscles
1. Erector spinae; 2. External intercostals; 3. Diaphragm; 4. Linea alba; 5. Rectus abdominis; 6. Tendinous intersections; 7. External abdominal oblique; 8. Transversus abdominis; 9. Internal abdominal oblique; 10. Pelvic diaphragm; 11. Perineum

Upper Limb Muscles
A. 1. Trapezius; 2. Pectoralis minor; 3. Pectoralis major; 4. Latissimus dorsi; 5. Rotator cuff; 6. Deltoid
B. 1. Triceps brachii; 2. Biceps brachii and brachialis; 3. Brachioradialis; 4. Biceps brachii and supinator; 5. Anterior forearm muscles; 6. Posterior forearm muscles; 7. Intrinsic hand muscles

Lower Limb Muscles
A. 1. Iliopsoas; 2. Gluteus maximus; 3. Gluteus minimus; 4. Tensor fasciae latae; 5. Anterior thigh muscles; 6. Posterior thigh muscles; 7. Medial thigh muscles
B. 1. Quadriceps femoris; 2. Sartorius; 3. Hamstring muscles; 4. Adductor muscles; 5. Gastrocnemius and soleus; 6. Anterior leg muscles; 7. Peroneus; 8. Intrinsic foot muscles

Location of Superficial Muscles
A. 1. Deltoid; 2. Biceps brachii; 3. Brachioradialis; 4. Adductors of thigh; 5. Sartorius; 6. Quadriceps femoris; 7. Vastus medialis; 8. Rectus femoris; 9. Vastus lateralis; 10. Tensor fasciae latae; 11. Flexors of wrist and fingers; 12. External abdominal oblique; 13. Rectus abdominis; 14. Serratus anterior; 15. Pectoralis major; 16. Sternocleidomastoid
B. 1. Infraspinatus; 2. Teres minor; 3. Teres major; 4. Triceps brachii; 5. Extensors of wrist and fingers; 6. Hamstring muscles; 7. Semitendinosus; 8. Biceps femoris; 9. Semimembranosus; 10. Soleus; 11. Gastrocnemius; 12. Adductor muscles; 13. Gluteus maximus; 14. Gluteus medius; 15. Latissimus dorsi; 16. Trapezius

QUICK RECALL

1. Body movement, maintenance of posture, respiration, production of body heat, communication, constriction of organs and vessels, and blood circulation (heart beat)
2. Contractility, elasticity, excitability, and extensibility
3. Epimysium (fascia) surrounds whole muscle; perimysium surrounds muscle fasciculi; endomysium surrounds muscle fibers
4. Resting membrane potential and action potential
5. Depolarization, which occurs when sodium ions move into the cell, and repolarization, which occurs when potassium ions move out of the cell; ion balance is restored by the sodium-potassium exchange pump
6. Presynaptic terminal of axon (with synaptic vesicles containing neurotransmitter), synaptic cleft, and postsynaptic membrane of muscle (with neurotransmitter receptors)
7. I band - actin myofilaments; A band - actin and myosin myofilaments; H zone - myosin myofilaments
8. Below a threshold stimulus there is no contraction; a threshold or stronger stimulus produces a maximal contraction.
9. Increased frequency of stimulation and recruitment
10. Isometric and isotonic (includes concentric and eccentric) contractions
11. Slow-twitch and fast-twitch fibers

WORD PARTS

1. myofilament; myofibril; endomysium; epimysium; perimysium
2. aerobic; anaerobic
3. sarcomere, sarcolemma
4. sarcoplasm, sarcoplasmic reticulum
5. synergist
6. synergist

MASTERY LEARNING ACTIVITY

1. C. The perimysium surrounds muscle fasciculi. The epimysium surrounds the whole muscle, and the endomysium surrounds muscle fibers.

2. D. Whole muscles are made up of muscle fasciculi. In each muscle fasciculi are many muscle fibers (cells). Each muscle fiber is composed of many myofibrils. The myofibrils consist of the myofilaments actin and myosin.

3. A. Actin myofilaments are attached to the Z disk, are not found in the H zone, and are thinner than myosin myofilaments.

4. A. An action potential is a reversal of the charge found in a resting membrane potential. In a resting membrane potentials the outside of the membrane is positively charged compared to the inside. Stimulation of the cell membrane results in the movement of positively charged sodium ions into the cell and a reversal of the charge. Thus stimulation produces an action potential.

5. B. An action potential at the presynaptic terminal stimulates the release of acetylcholine that moves across the synaptic cleft (where the acetylcholine binds to a receptor in the postsynaptic membrane. Consequently an action potential is produced in the skeletal muscle cell, after which the acetylcholine is broken down.

6. C. Action potentials in skeletal muscle move down T tubules and cause the release of calcium from the sarcoplasmic reticulum. The calcium binds to the troponin of actin myofilaments. As a result, tropomyosin moves, exposing attachment sites for myosin myofilaments. The myosin and actin combine to form cross bridges and contraction results.

7. D. Skeletal muscle requires ATP molecules for contraction, that is for movement of the heads of the myosin myofilaments. ATP molecules are also required for relaxation for two reasons: (1) ATP molecules are necessary for cross bridge release (myosin and actin unbind); (2) The movement of calcium into the sarcoplasmic reticulum requires ATP molecules. When calcium moves back into the sarcoplasmic reticulum the attachment sites between actin and myosin are covered by tropomyosin.

8. D. Increasing the frequency of stimulation increases the force of contraction of a muscle as the length of the relaxation phase decreases. If the frequency of stimulation is rapid enough there is no relaxation between stimuli and tetanus results. Recruitment results from increasing the number of motor units stimulated, and rigor mortis results from inadequate amounts of ATP molecules following death.

9. C. Anaerobic respiration produces lactic acid, does not require oxygen, produces fewer ATP molecules per glucose molecule than aerobic respiration, but produces them faster.

10. E. Creatine phosphate is an energy storage molecule that is quickly used to form ATP molecules. The ATP molecules are used in muscle contraction. Anaerobic respiration quickly produces additional ATP molecules, but can do so only for a short time. If oxygen consumption and delivery increases, aerobic respiration provides ATP molecules on a sustained basis.

11. A. A contraction in which the length of the muscle does not change is isometric. Because the weight did not move, the weight-lifter's limbs did not change position, and therefore neither did the length of his muscles.

12. A. Low myoglobin content is found in muscle that is predominantly composed of fast-twitch fibers. Such muscles can contract rapidly, but fatigue quickly. Chickens can fly only short distances. On the other hand, dark meat with high myoglobin content is typical of muscle predominantly composed of slow-twitch fibers. Such muscles are fatigue resistant; an example is chicken thighs.

13. B. Fast-twitch fibers are more abundant in the arms, which are capable of quick movements, than the back, which are fatigue resistant and maintain posture. A marathon runner has a higher proportion of slow-twitch fibers than a sprinter. Exercise does not cause one type of fiber to switch to another type. However, exercise can make fast-twitch fibers more fatigue resistant.

14. B. Smooth muscle can be autorhythmic. Cardiac muscle is always autorhythmic. Skeletal muscle does not have spontaneous contractions, whereas smooth muscle and cardiac muscle does. Cardiac muscle and skeletal muscle are striated, whereas smooth muscle is not. Skeletal muscle is multinucleated, whereas smooth muscle and cardiac muscle have a single nucleus.

15. D. Muscles that oppose the action of other muscles are antagonists. Muscles that assist each other are synergists. A prime mover is the muscle mostly responsible for a movement.

16. A. The temporalis and masseter muscles close the jaw.

17. D. The iliopsoas is responsible for most of the flexion that occurs between the trunk and thigh. The anterior thigh muscles also contribute. The rectus abdominis causes flexion of the vertebral column.

18. D. Extension of the forearm during a punch is critical to a boxer; the triceps brachii performs that function.

19. B. Contraction of the quadriceps femoris can cause the leg to be forcefully extended, as in kicking a football.

20. C. Because a ballerina often dances on her toes, plantar flexion of the foot is necessary. The gastrocnemius muscles perform that function.

FINAL CHALLENGES

1. Botulism toxin decreases acetylcholine release in the neuromuscular junction. This prevents action potentials in skeletal muscle cells. Thus the respiratory muscles (e.g., the diaphragm) relax and do not contract. Other explanations that you could have proposed because they would also lead to respiratory failure, would be that the toxin prevents acetylcholine from binding to its receptor on skeletal muscle cells, or that the toxin inhibits the production of acetylcholine.

2. In experiment A the student used anaerobic respiration as she started to run in place, but aerobic respiration also increased to meet most of her energy needs. When she stopped running, respiration rate is increased over resting levels because of repayment of the oxygen debt, which results from anaerobic respiration. In experiment B almost all of her energy comes from anaerobic respiration because she is holding her breath while running in place. Consequently, she has a much larger oxygen debt. One would predict that following running in place in experiment B her respiration rate would be greater than in experiment A, or that her respiration rate would be elevated for a longer period of time than in experiment A, or both.

3. Sally's aerobic exercise program of jogging has developed her slow-twitch muscle fibers and increased the fatigue resistance of her fast-twitch muscle fibers. Sunny's weight-lifting program consists of intense, but short, periods of exercise. This increases strength by increasing the size of his muscle fibers. Because it relies on anaerobic respiration, however, it does not develop aerobic, fatigue-resistance abilities. Sunny needs to do some aerobic exercises, which are included in most modern day weight-lifting programs.

4. The biceps brachii flexes the forearm. Its synergists are the brachialis and brachioradialis (both flex the forearm), and its antagonist is the triceps brachii (extends the forearm).

   The hamstrings extend the thigh and flex the leg. Its synergists are the gluteus maximus (extend the thigh) and sartorius (flex the leg); its antagonists are the iliopsoas (flex the thigh) and quadriceps femoris (extend the leg).

   The pectoralis major adducts, extends, and flexes the arm. Its synergists are the latissimus dorsi (adducts and extends the arm) and deltoid (extends and flexes the arm); its antagonists are the deltoid (abducts the arm) and latissimus dorsi (extends the arm).